REMARKS

Claim 84 has been amended as it was realized that the previous wording was technically inaccurate. The previous wording of the claim reflected the wording on page 10, lines 12-16; however, as explained in the accompanying declaration by Dr. Eugene Smotkin, the critical factor is the area-specific resistance (ASR) and by adjusting the thickness of the electrolyte, an ASR can be obtained which reflects a material with the desired conductivity.

As explained in Dr. Smotkin's declaration, the critical feature of an electrolyte for a fuel cell is the value of its ASR for protons. It must be sufficiently small that the voltage drop across the electrolyte is minimized.

ASR is related to conductivity by the simple equation:

$$ASR = L/\sigma$$

where ASR represents the area-specific resistance in $Ohm.cm^2$, L represents the thickness of the electrolyte in centimeters and σ represents the conductivity of the electrolyte for protons in Siemens per centimeter (S/cm).

It is apparent from this equation that as the conductivity of a material is decreased, the thickness of the electrolyte required to obtain a desirable ASR decreases as well, *i.e.*, the less conductive the material, the thinner the electrolyte must be.

As discussed previously during prosecution, it has been desirable to find a material for an electrolyte that is operable in, for instance, the range of 220°C-550°C. Electrolytes containing liquid, such as Nafion® 117, cannot withstand these temperatures. As shown by Figure 1 in the specification and in claim 84, reproduced from Norby (*Solid State Ionics* (1999) 125:1-11), materials with conductivities in the "gap" region which would permit their use as electrolytes at

reasonable thicknesses are not available. However, by adjusting the thickness of the electrolyte according to the equation shown above (claim 84 now reflects this), the required value for ASR can be achieved. The applicant has found that despite the lack of materials with the desired conductivities at temperatures in the gap, electrolytes operable at temperatures of 220-550°C can be constructed by utilizing very thin forms of available materials. However, this turned out to have the drawback that there was insufficient mechanical strength to permit these electrolytes to be used standing alone. It was applicant's insight that materials with poor conductivities could be adapted to serve as electrolytes by maintaining their integrity by supporting the electron-insulating proton-conducting (EIPC) electrolyte on a metal or metal hydride support.

The Office action to which this responds posits essentially two bases for rejection directed, at least in general, to all pending claims and both based on asserted obviousness over (purportedly) various combinations of documents. The first set utilizes Smotkin, *et al.* (U.S. 5,846,669) as a primary reference and various publications and patents (designated Norby, Crome, Kwang and Dorthe) as secondary documents. The second cites WO 98/21777 ('777) as a primary document and the same set of publications as secondary documents. In both cases, the secondary documents are cited as disclosing specific inorganic liquid-lacking electrolyte candidates which, the Office asserts, could readily be used in the invention. Each set of rejections is discussed below.

The Claims are Patentable Over Smotkin in Combination with Norby, Crome, Kwang or Dorthe

Although these rejections are said to be directed to all claims, it is noted that claims 78-79 and 87-88, which do specify particular electrolytes, are never actually discussed. It is assumed that this is an inadvertent omission and that the Examiner meant to specify these claims in discussing the

combinations themselves, for example, on page 5 where the Office says "Smotkin, *et al.*, '669 does not expressly disclose a specific coating material" (such statements appear in all rejections made using Smotkin as primary document). The remainder of the claims appear to be rejected over Smotkin taken alone.

Claims 75, 82, 84 and 91 are first discussed. Respectfully, while Figure 1 of Smotkin is accurately reproduced, applicant believes that the Office has misinterpreted this document. The Examiner's italicized statement that "the metal hydride foil serves as the support which is coated on both sides by respective electrolyte-containing matrices which represents the inorganic/composite non-liquid material" is not correct. Smotkin discloses the use of a "dense phase proton permeable material" that comprises palladium hydride (column 4, lines 57-63), but it *does not support anything*. Rather, it separates liquid-containing electrolytes so that "crossover of larger chemical species from one electrode side to the other electrode side of the fuel cell" is prevented (column 2, lines 63-65). A required feature, apparently, of the Smotkin disclosure is "the simultaneous use of both acid electrolyte and a base electrolyte which is made possible by the presence of a dense phase such as a foil of proton-permeable material which physically separates the acid and base to the electrode compartments where they are most beneficial to electrochemical performance" (column 3, lines 42-47). This is, of course, in contrast to the claimed invention herein *which specifically requires there be no liquid phase present*.

Thus, Smotkin fails to disclose or suggest a metal or metal hydride support which is coated with an inorganic material that contains no liquid phase. Since this is the case, Smotkin cannot suggest that an inorganic material that contains no liquid phase should have a thickness with an

ASR for protons in the required range of claims 75 and 84, or that such thickness would necessitate the use of a solid support.

With respect to the remarks further made by the Office, applicant believes it is not relevant to a rejection for obviousness that the inorganic material (please note composite materials are no longer in the claims) cover a "very large number of applicable materials." Any materials that presumably must have in inherent characteristic of the required ASR must be those disclosed in a document cited by the Office. The only such document is Smotkin, and without any experimental determination, it must be apparent that if there were no liquid acid or base added to the Smotkin matrices on either side of the metal or metal hydride foil, the ASR could not be in the required range, since the matrices alone cannot serve as electrolytes in fuel cells. This is verified by the declaration of Dr. Smotkin as well.

Of course, there is no actual disclosure in Smotkin of any support which is coated with matrix alone absent the liquid electrolyte.

As to the relevance of the preamble, this has been discussed previously in the context of *Corning Glass Works v. Sumitomo Electric U.S.A., Inc.*, 868 F2d 1251, 9 USPQ2d 1962 (Fed. Cir. 1989) which makes clear that where the preamble imposes structural features on the subject matter of the claims it does indeed constitute a claim limitation. This appears to have been ignored by the Office. Nevertheless, this consideration appears irrelevant as the cited documents pertain to components of fuel cells in any event.

With respect to claims 76-77 and 85-86 and to claims 80-81 and 89-90, the nature of the metal and thickness of the metal foil as disclosed in Smotkin are not disputed.

The discussion provided by the Office to this point, which refers to claims 75-77, 80-82, 84-86 and 89-91, appears to relate to Smotkin taken alone. It is only after stating that Smotkin does not expressly disclose a specific coating material (without mentioning the claims (78-79 and 87-88) that actually do specify coating materials) that the secondary documents are discussed.

The secondary documents at best suggest some specific electrolytes that might or might not be suitable for use in the present invention. There is no assertion on the part of applicant that new materials, invented by him, are the basis for patentability. The invention employs well known materials which have, however, not successfully been used as electrolytes in fuel cells in the temperature range required. Norby, specifically, indicates that there are no materials that seem to have appropriate conductivities in the gap of Figure 1. At least some of the materials shown in Norby (which are not satisfactory according to Norby's position) such as BCN18 are included in claims 78-79 and 87-88 since, by virtue of the present invention, applicant has found a way to employ such materials. Apparently, the material mentioned in Crome noted by the Office does not match any in the claims, and indeed, Crome is directed to an entirely different issue – a particular construction of ceramic tubes for various applications. As to Kwang (sic, Ryu), again, it is acknowledged that materials useful in the invention are known in the art. As to Dorthe (sic, Lybye), it does not appear that the material set forth in this document is listed as a specific electrolyte in the present claims.

In summary, the secondary documents, even to the extent that they disclose materials that might be claimed specifically as electrolytes, fail, when combined with Smotkin, to suggest the invention since there is no suggestion that these materials could be successfully used in fuel cells by supporting them as very thin coatings on metal or metal hydride foils. Such foils are disclosed only

as separating membranes by Smotkin, not as supports for inorganic electrolytes that contain no liquid phase.

Accordingly, the group of rejections based on Smotkin in combination with the various secondary documents may be withdrawn.

The Claims are Patentable Over the Combination of WO 98/21777 with Norby, Crome, Kwang or Dorthe.

As has been noted earlier in the prosecution, WO 98/21777 has only an abstract in English, but corresponds to U.S. patent 6,242,122 which is entirely in English. Judging from the abstract of '777, it appears that a palladium silver alloy is used in a manner analogous to the platinum/platinum hydride foil of Smotkin, simply to separate liquid components of electrolytes in fuel cells. There is no suggestion at all in this document that an inorganic material that contains no liquid phase be employed as an electrolyte in fuel cells with or without a metal foil.

As was the case with respect to the rejection over Smotkin, *et al.,* it appears that most claims are rejected in fact over the primary document alone, Only, for example, on page 17 does the Office state that this document "fails to reveal the particular coating material" and presumably has neglected to mention claims 78-79 and 87-88 which require such specific materials.

With regard to claims 75, 82, 84 and 91, the disclosure of WO '777, as characterized by the Office, appears to rely solely on the abstract and accompanying figure. The Office states that the electrolyte layers "represent(s) the inorganic/composite non-liquid material." Again, the Office is reminded that composite materials are no longer in the claims and the claims are directed to inorganic materials which contain no liquid phase. There is nothing in the abstract or the figure which indicates that the electrolyte (layers 4 and 6) is either inorganic or does not contain any liquid.

The Office is again reminded that in order to defeat patentability it is necessary to cite a document which discloses or suggests the elements of the claims. It is not sufficient to state that there may be some component somewhere that employs a metal or metal hydride support coated with an inorganic material that contains no liquid phase. That has to be disclosed in a document, not speculated to exist, independent of any requirements for ASR as a function of temperature. It is impossible for applicant to provide evidence that "the prior art coated component" has a different ASR than that required when no prior art component has been described.

As before, the relevance of the preamble appears moot as the cited document concerns fuel cells.

As to claims 76-77, 80-81, 85-86 and 89-90, the use by WO '777 of a palladium silver alloy is not disputed, nor is the thickness range (although applicant assumes 5-50 μ rather than Tm is meant).

The arguments with regard to the secondary documents are identical to those set forth above, and applicant believes they need not be repeated here, as the same secondary documents are cited in the same manner.

In Regard to "Response to Arguments":

Applicants wishes merely to comment that the thickness of the electrolyte layer is inherent in the requirement for the value of the ASR and need not be stated explicitly. This is governed by the equation described above and further elucidated in Dr. Smotkin's declaration. In any event, the desirability of including a thickness parameter is not clear since the Office has been unable to provide any document which discloses a metal/metal hydride support coated with an inorganic material that has no liquid phase.

Conclusion

In light of the failure of either primary document alone or together with the secondary documents to disclose or suggest using a metal/metal hydride support coated with an inorganic material that has no liquid phase, applicant believes that there is no basis for finding the claims unpatentable. This is irrespective of the further requirement for a desired ASR as explicitly specified (claim 75) or as would be required for an inorganic electrolyte without liquid to serve as an electrolyte comparable to Nafion® 117 at 80°C (claim 84). It is also irrespective of the effective structural limitation imposed by the preambles that the ASR be suitable for use as an electrolyte in fuel cells.

No document which describes or suggests a metal/metal hydride support coated with an inorganic material lacking a liquid phase has been cited, and applicant is aware of none. Applicant therefore respectfully requests that claims 75-82 and 84-91 be passed to issue.

In the unlikely event that the transmittal letter is separated from this document and the Patent Office determines that an extension and/or other relief is required, applicant petitions for any required relief including extensions of time and authorize the Assistant Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to **Deposit Account No. 03-1952** referencing docket No. 491712000100.

Respectfully submitted,

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